MANDALAY PIPELINE PROJECT

GEOPHYSICAL SURVEY

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REPORTED TO: SOUTHERN CALIFORNIA EDISON CO.
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MANDALAY PIPELINE GEOPHYSICAL SURVEY

1. INTRODUCTION

Southern California Edison requested EcoSystems Management Associates, Inc., to conduct a geophysical survey of the Edison Mandalay Pipeline, a marine oil supply line that served the Mandalay Generating Station. This survey is the initial component in gathering the necessary environmental information for the abandonment process as obligated under the lease agreement with the State Lands Commission.

2. DESCRIPTION OF PROJECT SITE AND REGIONAL PHYSIOGRAPHY

Mandalay Beach is located on the California coast between Ventura Harbor and Channel Islands Harbor (see Figure 1). Mandalay Beach is approximately 3 miles west of the City of Oxnard, and about a half-mile north of Fifth Avenue.

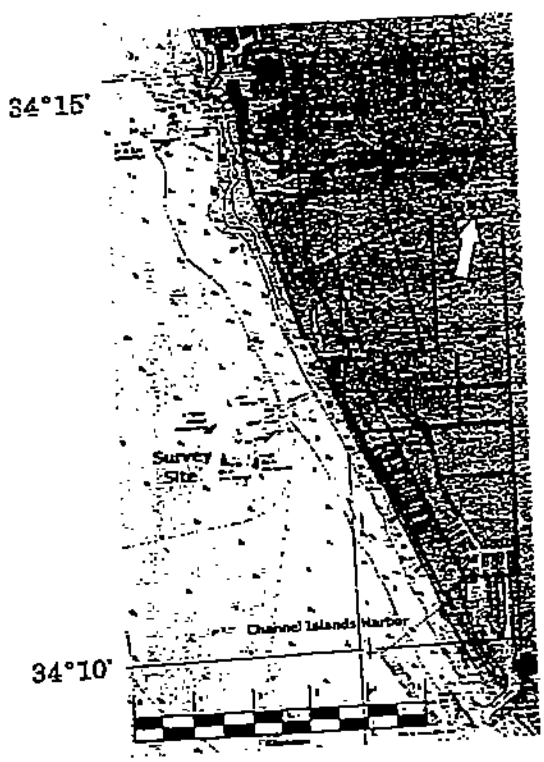


Figure 1 showing the general location of the survey site.

The site is on the coastal plain of the Ventura Basin, approximately 18 miles northwest of Point Mugu and 2 miles south of the mouth of the Santa Clara River. The Ventura Basin is defined by the Ventura River delta to the north and the barrier beaches at Point Mugu to the south. Ventura Marina is located 2.5 miles north of the site and Channel Islands Harbor is 3 miles south. Mandalay Beach is characterized as an expansive straight sandy beach with a series of intact low-lying protective dunes on the inland side. The offshore (mainland) shelf at Mandalay Beach is narrow, about 5 to 6 miles wide, and is about 5 miles north of the Hahnium Submarine Canyon. This area of the coast is strongly influenced by the adjacent Channel Islands.

The Mandalay Beach area is known for strong nearshore currents and significant nearshore sand movement. The first pipeline site survey, performed by Pafford & Associates (letter report to Southern California Edison, December 31, 1957) noted that while divers were taking bottom sand core samples they noted "intermittent forces were moving the divers toward shore". Further, a May 22, 1972 letter to Edison from the Chevron shipping Company regarding the upgrading of the moorings at that time stated "Our Mooring Masters have experienced at Mandalay the strongest currents of any terminal on the coast". Net littoral sediment transport is downcoast and amounts to 800,000 to 1,200,000 yds^3 per year. Some of the southerly migrating sand is being trapped by the Ventura Marina breakwater and jetties. However, large amounts of silts and sands are put into the littoral system by storm loads coming into the ocean from the Santa Clara River.

3. DESCRIPTION AND HISTORY OF THE PIPELINE

The Mandalay Pipeline is a single 24 inch diameter seamless marine pipeline extending 4950 feet offshore at a bearing of 250 degrees from the beach/terminal facility adjacent to the south end of the Mandalay Generating Station. The pipeline was used to off-load oil from ships, but has been officially in "caretaker" status since February 1993. In 1992, the offshore terminus ship-mooring buoys and anchor chains were removed from the site. Table 1 describes mooring anchor positions taken from SCE Drawing 5128864-4. The anchors lettered "A" through "G" were concrete block, and were attached to the surface buoys. The anchors marked "1" through "7" were the 10-ton metal Danforths chained behind the concrete blocks "A" through "G"respectively. The "reflector" (semi-spherical block) and "spar" (a cube- shaped block) anchors were also made of concrete.

Table 1 Mooring positions for the offshore oil transfer terminal.

Location Name	N	E
Radar reflector	257148.94'	1,614874.19'
Anchor "A"	256521.44'	1,616909.11'
Anchor # 1	256111.44'	1,616909.11'
Anchor "B"	256596.44'	1,617379.11'
Anchor # 2	256186.44'	1,617379.11'
Anchor "C"	256813.59	1,617866.96'
Anchor # 3	256523.68'	1,618156.87'
Anchor "D"	257148.94'	1,617984.11'
Anchor # 4	257148.94'	1,618394.11'
Anchor "E"	257484.29'	1,617866.96'
Anchor "F"	257701.44'	1,617379.11'
Anchor # 5	257774.20'	1,618156.87'
Anchor # 6	258111.44'	1,617379.11'
Anchor # 7	258186.49'	1,616909.11'
Anchor "G"	257776.44'	1,616909.11'
Spar Buoy "End of Pipeline"	257233.94'	1,617054.11'

*California Coordinate System positions in Table 1 based on NAD-27

Only one set of concrete and Danforth anchors was removed in 1992 because it was determined during the salvage operation that the barge crane was in jeopardy of toppling due to lifting loads required to pull the anchors out of the sand in which they were buried. The offshore mooring end, "sea hose" (flex) part of the pipeline, was removed and the 24 inch line was capped in a trenching operation at that same time. The capped pipeline was hydro tested to 250 psig and then flooded with a water solution containing an oxygen scavenger (catalyzed sodium bisulfite), and a biocide (an aqueous solution of metronidazole, dimethyl formanide, and isopropanol). The buoys, chains, and anchors that were removed from the site in 1992 were stored on land at the Ormond Beach Generating Station until 1997, at which time they were salvaged.

4. PROJECT DESCRIPTION

A reconnaissance visit to the site was made on 2 February 2000. The information acquired from this visit was used to develop a work plan for the beach and offshore geophysical survey. The survey was performed in two phases. Phase One was devoted to the onshore topographic survey and was conducted on 16-17 February and 22 March 2000. Phase Two was scheduled to provide all of the offshore data and was conducted between 21 February 2000 and 3 March 2000 with field data collection from 28 February to 3 March. Through-the-surf diver survey profiles were undertaken on 22 March 2000.

PHASE 1 Beach & Dune Topographic Survey

Phase 1 surveyed the onshore portion of the site to determine beach and dune elevations. It was conducted by walking transect lines with a precision positioning system and recording the XYZ positions of the surveyor every 50 feet.

The beach and dunes survey was conducted on 16-17 February 2000 using a TRIMBLE 4000 SSI Global Positioning System (G.P.S.) operated by Peter and Associates (Figure 2).

Figure 2 Shows the survey in progress and illustrates the instrumentation.

Beach profiles were carried out into the surf zone to tie in with the data collected offshore from the survey boat.

The size of the beach & dune survey area was 1,500' long by 450' wide. Data was collected at 50' increments along predetermined lines. Accuracy of the data collected is one centimeter horizontal (latitude/longitude) and two centimeters vertical.

At the north part of the site where the cooling water system from the generating station is located the land survey established positions along the boundary fence (corners), the rock and cement outfall structure, and sediment levels at several points in the outfall stream bed (Figures 3 & 4). The dune fields in the southerly portion of the survey area that cover the pipeline are shown in (Figure 5). It can be seen that the dunes are partially fixed in place by vegetation.

Figure 3 Shows the outfall basin.

Figure 4 Shows fence corner monumentation.

Figure 5 is a view of the dunes in the survey area.

A handheld/backpack magnetometer was utilized, as part of the 22 March 2000 beach and surf zone survey, to locate the position of the buried pipeline on the beach.

<u>PHASE 2</u> Offshore Geophysical Survey

Phase 2 of the survey was devoted to the collection of data in the offshore area. The survey area was approximately 3000' (914m) wide by about 6500' (1980m) in the offshore direction.

Data was collected to determine the bathymetry of the area, bottom type, (sand or hard substrate), location of any reefs, location of the pipe lines, the depth of overburden on the pipelines, and to determine if the sea floor was encumbered by any unknown or previously un-encountered natural or human-related objects. The equipment used for the survey included a precision fathometer, a side scan sonar system, a 3.5 kHz sub-bottom profiler, and a magnetometer.

5. METHODS

DESCRIPTION OF EQUIPMENT & FIELD PROCEDURES

PHASE 1 Beach & Dune Topographic Survey

The land survey system consists of a Trimble 4000SSI base station (35 watts) and rover unit (2 watts), along with a "Blue Brick" radio system. The base station/rover were calibrated to known control monuments (NAD83) for latitude and longitude and NGVD1988 for vertical control (see Table 2 for reference datum).

The TRIMBLE 4000 SSI is a powerful real-time G.P.S. survey receiver based on Trimble's advanced dual frequency G.P.S. technology. It computes centimeter accuracy positions in the field in seconds while only needing 5 seconds pause at each fix point. This accuracy level is obtained by differentiating G.P.S. between the base station and rover to a known monument (NAD83). Data collected was stored in the Trimble SCI palmtop (Rover) and downloaded to a computer.

After the base unit was set-up, the rover was powered up and transported to three (3) known control monuments where the G.P.S. system base/rover was calibrated. The control monuments used were:

"CROSS"	Located in Ventura at the Sera Cross in the Grand Memorial Park
"GREEN CASTLE"	Located in Oxnard on Channel Islands Blvd. at the bridge crossing the Edison Canal.
"NAVIGATOR"	Located in Ventura at the intersection of Harbor Blvd. and Olives Park Rd.

Once calibrated, the land surveyor started to collect data in the form of latitude, longitude and vertical elevation along with attribute description. Table 2 provides a reference for different datum used and shows their relationships to other standards.

Table 2 Elevations of Tidal Datums Refereed to Mean Lower Low Water (MLW) for Nearest Tidal Bench Mark: Port Hahnium (From NAA - National Ocean Service)

Datum Description	Abbreviation	Elevation in feet	Elevation in meters
Highest observed water level (2/4/58)	HOWL	7.67	2.34
Mean Higher High Water	MHW	5.47	1.67
Mean High Water	MHW	4.70	1.43
National Geodetic Vertical Datum	NKVD-1929**	2.88	0.88
Mean Tide Level (mean sea level)	MTL	2.84	0.87
Mean Low Water	MLW	0.98	0.29
North American Vertical Datum	NAD-88*	0.47	0.14
Mean Lower Low Water	MLW	0.00	0.00
Lowest Observed Water Level (1/7/51)	LOW	-2.33	-.71

* Terrestrial Surveying Standard

** NKVD reference based on adjustment of 1973 and NOS levels of 1940. Fixed Datum of 1929.

During the survey, data was stored real time in the handheld Survey Controller [model TSC1 (with 4 Mb)]. Data was down loaded into the computer and was then processed using "Surfer" software to plot the data. The data provided in the various figural presentations in this report is in meters.

PHASE 2 Offshore Geophysical Survey

The offshore survey was performed aboard the ECO-M Farrallon survey vessel. A standard grid survey pattern was used to control the survey. The preplot was designed to provide 400% overlap of the survey area by the side scan sonar.

The survey used a standard suite of geophysical instrumentation for shallow water surveys. All of the instruments were operated at the same time.

A. NAVIGATION Differential Global Positioning System

The DGPS is an all-weather, radio-based, satellite navigation system that enables users to accurately determine 3-dimensional position, velocity and time. The overall system consists of three major segments. The space segment, the ground segment and the user segment.

The space segment is a constellation of satellites operating in 12-hour orbits at an altitude of 20,183 km. The constellation contains 21 satellites (plus three spares) in six orbits, equally spaced about the equator and inclined 55 degrees.

The user segment is the collection of all G.P.S. user receivers. G.P.S. receiver position is determined by the geometric intersection of several simultaneously observed ranges (satellite to receiver distances) from satellites with known coordinates in space. Basic G.P.S. accuracy in autonomous mode is approximately 25 meters.

The Differential mode offers the user accuracies on the order of 1-2 meters. The ECO-Systems DGPS consists of a Motorola SIXGUN Model 620 receiver, and an OMNISTAR Model 6300 receiver / processor for reception of differential corrections. It is an all-weather, radio-based, satellite navigation system that enables users to accurately determine 3-dimensional position, velocity and time.

The ECO-systems ECO-NAV 5 Navigation Computer provides a permanent record of the ranges, line and shot point number updating, Helmsman Correct Course Steering display, real time, and other features. Data is automatically stored on hard drive and on 3.5" diskette for backup.

Prior to each survey, the intended path of the boat is laid out on a chart and the coordinates for each leg are obtained. This is referred to as a "pre-plot". When in the field, the Helmsman Correct Course Steering display is used as an aid to keep the boat on the intended track.

The actual path of the boat, or "vessel track", is later charted from the data stored on the floppy disk by using a 36 inch X-Y plotter. This is called the "post-plot".

B. <u>BATHYMETRY</u>

METHOD THEORY

This system determines the distance between the transducer and underwater objects, such as: the sea bed, benthic algae, or fish, and displays the results on a graphic recorder. The principle is based on physical laws that define the velocity of sound in water. When short pulses of high power acoustic energy (32 times per second) are emitted from a transducer, the propagating sound wave, when striking any underwater object, is reflected back toward the source. Thus by measuring the time differences between the transmission of a sound wave and the reception of the reflected signal, the distance to an object can be determined (ie. depth to the sea-floor).

This Sonar system provides (for our purposes) two different types of information which are necessary for data analysis and the production of maps. First, the recorded depth data is digitized and correlated with each specific horizontal position acquired with Differential Global Positioning System (DGPS). The second function, which is the ability to utilize return signal strength variation to differentiate sediments versus hard rock, provides boundaries between outcropping rock and sediments. This aids in the side scan interpretation of sea bed substrate.

OPERATIONAL METHODS

The bathymetry system for this project utilized a 200 kHz narrow beam width (9 degree) piezoelectric transducer powered by a Sonar Transceiver (300 watt). The data (continuous at two second interval) was recorded on a Precision Graphics Recorder (EPC 9800) and stored on disc. The data is automatically correlated with navigation information from the ECO-NAV5 Navigation System. The transducer was located 3.5 m behind the DGPS antenna. Resolution is ± 5cm.

At the beginning and end of each survey day a calibration was performed utilizing the "bar check" method as described in the "Hydrographic Manual," U.S. Department of Commerce, Publication 20-2. This calibration was then utilized to calculate water depths from the digitized data. These depth soundings were then corrected to MLW for tidal fluctuation, using the NOAA, 6 minute tidal data from the Los Angeles Harbor tidal station. Data are obtained from the WEB at www.olld.nos.noaa.gov./prelimwl.html.

The final corrected depth data was merged with the navigation data and imported into "SURFER" where it was plotted, edited, gridded and the final contours produced.

C. <u>SUB-BOTTOM PROFILER</u>

METHOD THEORY

Sub-bottom profiling systems employ piezoelectric transducers, operating at stated frequencies. They are housed in towing vehicles to reduce water-surface and ship noise. The transducers, submerged in the water, are connected via cable to a transceiver which consists of two major electronic components; a transmitter and a signal processor.

On command from the graphic recorder, transmitters provide up to 3000 Watts of power to the transducers. Only single wavelets of the respective frequency are applied to a transducer (thereby increasing resolution).

The signal processor first amplifies the received echoes from the transducer, conditions the signal through the TVG (Time Variable Gain), and then enhances the signal to a level suitable for input to the graphic recorder.

The 3.5 kHz system provides penetration in unconsolidated sediments up to approximately 20 meters. Deeper penetration can be achieved where very strong reflectors (relevant to normal sediments) exist.

Frequency selection is of primary importance in order to acquire proper penetration and resolution in different types of underwater strata.

Good resolution in sub-bottom recording is directly related to the proper use of pulse length and transceiver bandwidth. In order to resolve individual signals from closely spaced reflectors, the duration of the transmitted pulse must be short to avoid blurred or multiple imaging of the target. When the time duration of the transmitting pulse becomes comparable to the distance between echo making targets (two ways) divided by the velocity of the sound in water (approximately 1500 m/sec.), then two targets will not be resolved.

OPERATIONAL METHODS

Seismic recording in shallow water requires relatively moderate penetration but good resolution. High frequency sound-source pulses are greatly attenuated in sediments and do not provide good penetration while low frequency systems penetrate well but have poorer resolution. A 3.5 kHz profiling system is usually optimal. Data are recorded on a 19-inch EPC 9800 graphic recorder correlated with the DGPS navigation data as well as shot point, date, and time.

The 3.5 kHz system is towed along side the survey vessel while data is simultaneously collected and correlated with navigation information from the ECO-NAV 5 Navigation System. This data is stored on computer and transferred to the lab.

The EcoSystem 3.5 kHz system utilizes a Transceiver with 3000 watts power output providing cross communication with the towed transducer vehicle (fish) containing four MASSA T15 transducers. The fish was towed at 2.0 meters depth with a 2.5 meters offset from the DGPS antenna. The transducers fired at the rate of 16 times per second. The Receiver with TVG (time variable gain) provided signals to the EPC model 9800 thermal graphic recorder that has a resolution of 203 dots per 2.5 cm (1") and a vertical exaggeration of 1:6.

Figures 6 and 7 show the analog data acquired on the site. Figure 6 is a 3.5 kHz sub-bottom profiler record showing the depth of marine sediments overlaying a more consolidated sub-bottom layer. Figure 7 shows a typical crossing of the pipeline and its depth of burial.

The analog records are interpreted and then digitized on a CalComp Drawing Board II. The digitized records are then converted to sediment thickness using a speed of sound of 1675 m/sec (Hamilton, 1974). The sediment thickness data is merged with the navigation data and is used to generate isopach maps using "Surfer" software.

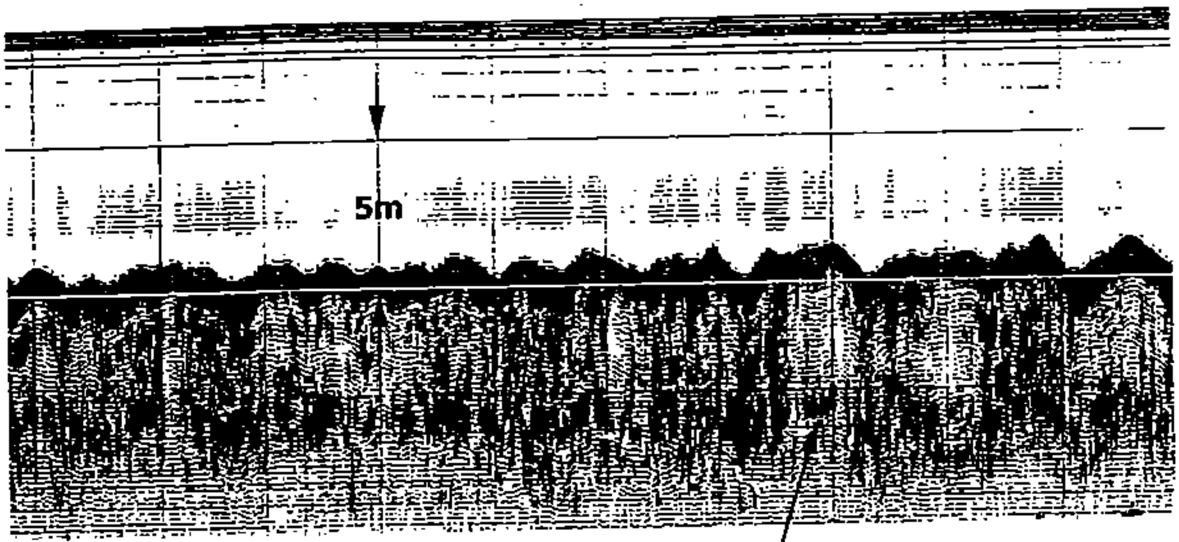


Figure 6 A 3.5 kHz sub-bottom profiler record showing the primary sub-bottom horizon present in the area of the survey. The reflector can also be seen in Figure 7.

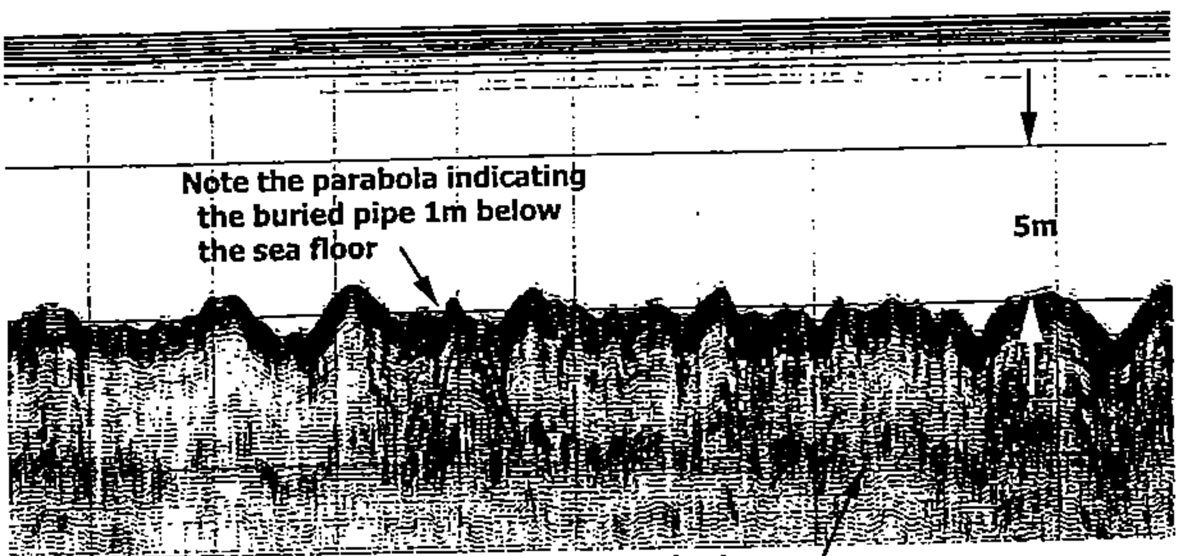


Figure 7 A 3.5 kHz sub-bottom profiler record showing a pipeline crossing (parabola).

D. SIDE - SCAN SONAR

METHOD THEORY

Side scan sonar data are used for the identification and delineation of sea floor characteristics that can form the basis for the analysis of sea floor changes. The side scan sonar tow fish contains the transmitting circuitry to energize the transducers which then emit high intensity, high frequency bursts of acoustic energy in fan-shaped beams which are narrow in the horizontal plane and wide in the vertical plane. A graphic recorder produces a continuous permanent graphic record of the sea floor topography, and objects on the sea floor, including data from the water column. For synchronization, the recorder generates trigger pulses and sends them to the tow fish and waits for the sonar echoes. Signals are electronically processed and printed line-by-line to produce the sonar image.

These sound waves project along the seabed on both sides of the moving vessel. Objects, topographic features, and substrate changes on the seabed produce return echoes, correlating to the objects encountered by the sound waves, which are received by the transducers, then amplified and sent up the tow cable to the graphic recorder on the vessel.

OPERATIONAL METHODS

A Klein 595 Side Scan Sonar System with a 500 kHz towed fish was utilized for this project. The system consists of a graphic recorder with a digital processor and a towing fish with dual transducers. The range was set at 50m (164') on each side of the survey vessel.

The recorder is a high speed dry thermal printer in which each dot is individually digitally addressed to produce 16 distinct gray shades on 48 cm (19.2") wide paper.

The side scan sonar coverage was approximately 400%. The survey lines were spaced 30.2m (100') apart.

The interpretation of the side scan records are done on plots of the vessel tracks, where objects from the down-looking sonar records are marked. Interpretation worksheets are then digitized on a CalComp Drawing Board II into AutoCAD and an AutoCAD DXF file is produced.

E. MAGNETOMETER

METHOD THEORY

The Geometrics G-881 Marine Magnetometer employs a Cesium atomic magnetic resonance device operating as the frequency controlling element of an oscillator. The frequency of the oscillation varies directly with the external magnetic field at the sensor. The frequency is continuously measured with great accuracy, yielding precise measurements of the surrounding magnetic field.

The Cesium sensor is combined with a CM-201 Larmor counter and ruggedly packaged for small boat operations. The sensor is towed behind the boat. A Toshiba 400CS computer, using MagSea™ software, is used to log, display, and print data transmissions from the sensor.

OPERATIONAL METHODS

The G-881 magnetometer produces a Cesium Larmor frequency output at 3.49872 Hz per nT (nT refers to nanotesla or gamma or 10^{-5} gauss). Thus, in a nominal 50,000 nT field, which is changing with changes in geographic position, the operating frequency is about 175 kHz. This frequency is measured and counted at a rate of 10 readings per second.

The operating range of this unit is 20,000 to100,000 nT depending on geographic position. The unit has automatic hemisphere switching. The counter sensitivity is typically 0.02 nT at 0.1 second.

Search Procedures:

The G881 magnetometer is designed for operation from small boats in shallow water. When surveying the G 881 is continuously towed as part of the overall survey package which included the Side Scan Sonar, 3.5 kHz sub-bottom profiler, and fathometer.

The data was displayed on the computer bi-modally (2 scales 50 & 500 nT), while the data was stored on the hard disc. Pipeline anomalies were normally about 200 to 300 nT over the regional background magnetic field. The pipeline was also visible in the 3.5 kHz data (Figure 7).

F. GROUND-TRUTH AND SURF ZONE DIVER SURVEYS

FIELD METHODS

Ground-truth diver surveys are conducted by relocating a target previously seen in the survey data (side scan sonar and magnetometer), dropping a buoy on the position, and deploying the divers. Once on the sea floor the divers perform a standard circular search covering an area approximately 100' in diameter (unless water visibility is high and targets can be located directly). Any objects encountered are evaluated and reported.

A surf zone diver survey was conducted to better tie together the offshore and onshore surveys. Bottom conditions were noted as the diver traversed the area.

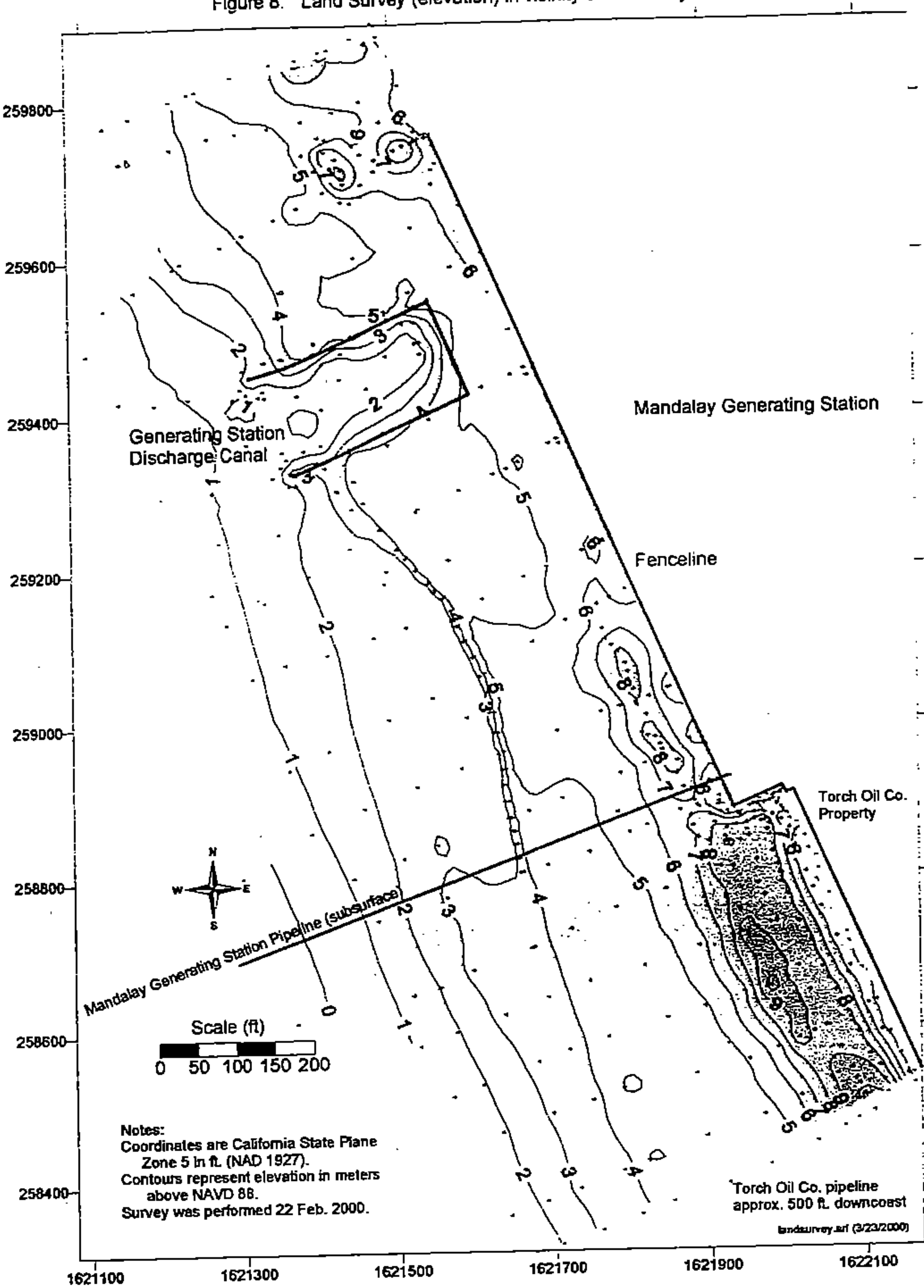
6. RESULTS

PHASE 1 Beach & Dune Topographic Survey

The land survey was conducted on the 21 - 22 February and 22 March 2000. The survey started with locating suitable bench marks for calibration of the three (3) dimension layout. Three survey control stations were visited to establish high order calibration of ± 2 cm on the vertical axis. The instruments were also calibrated for horizontal accuracy also at ± 1 cm using the USGS vertical datum.

The procedures, as described earlier in the methods section, were implemented and the elevation results of the land survey are provided in Figure 8 using NADVD-88 as the reference datum (Table 2). Contours represent elevations in meters above NADVD-88.

Figure 8. Land Survey (elevation) in vicinity of Mandalay Power Plant



It should be noted that this area experiences frequent elevation changes due to shifting sands during storms. Observable differences were noted between the initial reconnaissance survey of 2 February 2000, the topographical survey of 21-22 February 2000, and the beach/surf zone dive survey of 3 March 2000. During the survey period beach elevation and surf zone sand bar differences were especially evident by the berms cut into the beach in front of and downcoast of the Mandalay Generating Station near the across-the-beach cooling water outfall.

During the March 22 2000 the pipeline was located, both onshore and in the surf zone, using a hand held magnetometer. The pipeline was probed for at the location of the strongest magnetic anomaly with a 3 foot long probe, and was not found. A 3 foot deep hole was dug in the wet zone of the beach and the pipeline was probed for again. The pipeline was not found with the probes indicating the depth of sand on the beach was at least six feet and possibly greater than nine feet over the buried pipeline.

<u>PHASE 2</u> Offshore Geophysical Survey

The marine survey started on 28 February and continued to 3 March 2000. The survey boat, equipped with the instrumentation described in the methods section, surveyed approximately 447 acres using a 30.4 m (100') square grid. Five thousand seven hundred seventy shot points were collected and processed. Figure 9 shows the post-plot of this survey.

The side scan, sub-bottom sonar survey, and diver ground-truth observation results show that the offshore area is covered with coarse sand varying in depth over the primary consolidated lower horizon from about 2 meters (6.6') offshore to 6.5 meters (21.3') inshore. The Mandalay pipe line is generally covered with 1 - 2 meters (3.3' - 6.6') of sand. The sub-bottom isopach map Figure 10 depicts, in meters, the depth of a sand over the more consolidated sub-bottom. The thickness of the sand covering the pipelines is also shown on the same map.

Bathymetric results are provided in Figure 11. The bathymetry shows an evenly prograding sand covered sea floor from the inshore to the offshore of the survey area.

Figure 9. Vessel Track for Mandalay Power Generating Station Survey (March 2000)

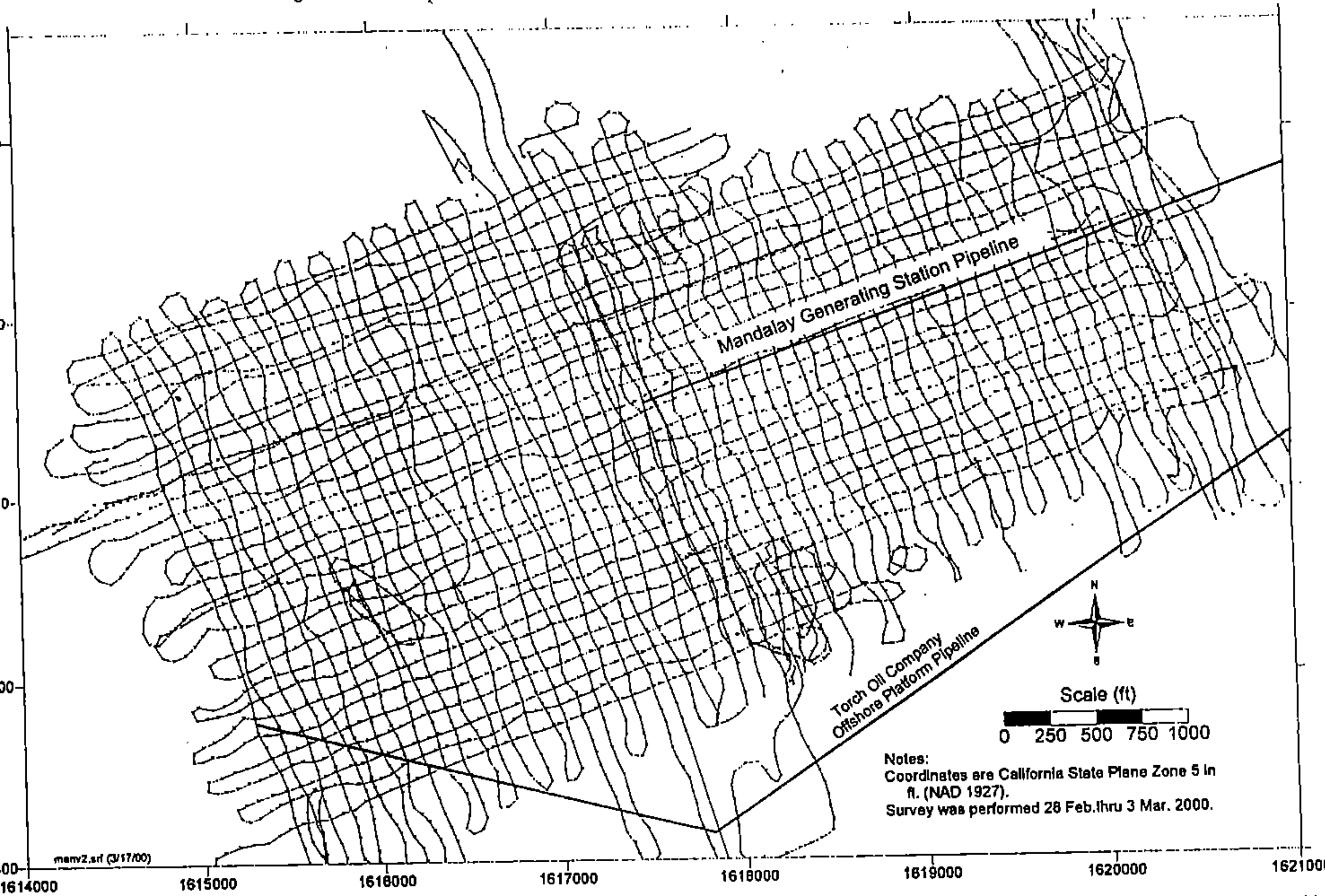


Figure 10. Sediment Thickness and Substrate Type Offshore of the Mandalay Power Generating Station (March 2000)

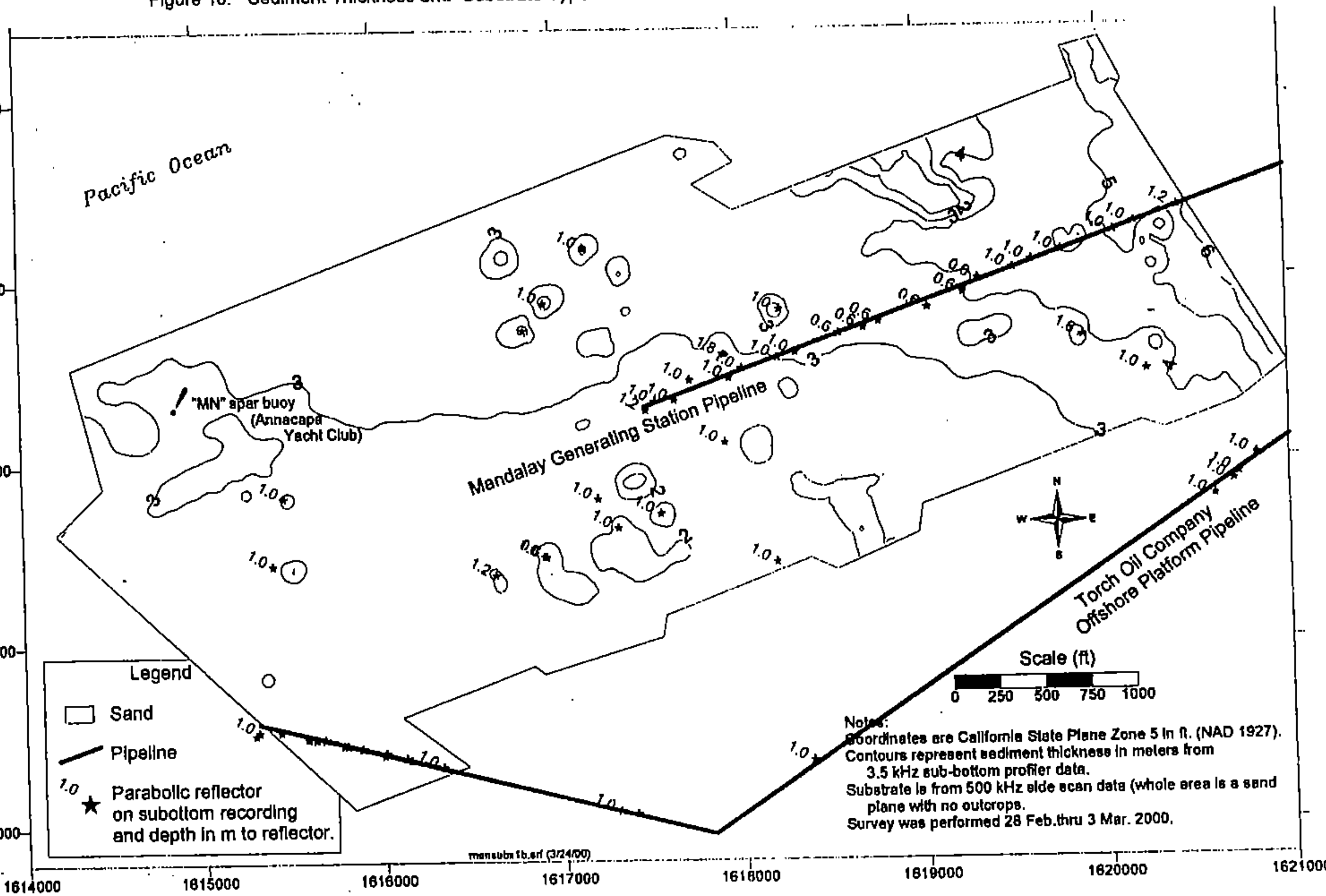
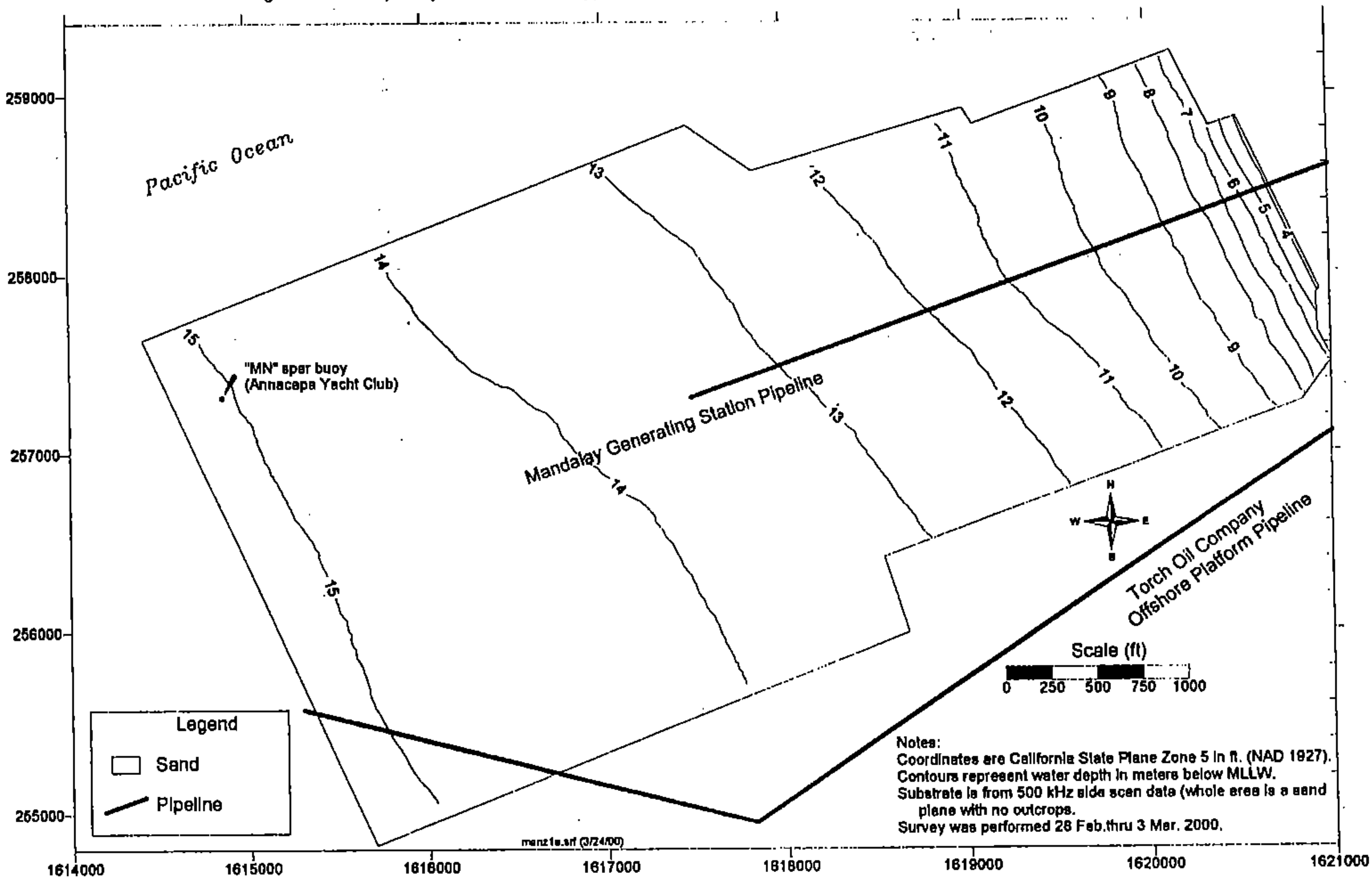


Figure 11. Bathymetry and Substrate Type Offshore of the Mandalay Power Generating Station (March 2000)



The side scan sonar data shows that the pipeline is not exposed above the sea floor. The offshore area where buoy anchors were located (see Table 1) was carefully examined and there were no observable man-made objects or exposed debris on the sea floor.. The offshore ground-truth dives were conducted on 3 March 2000 on the few targets seen on the side scan sonar record. Several of the small targets were investigated by divers and were determined to be only hard-packed sand ripples approx. 2 cm (.78") in height and schools of fish.

The magnetometer was used continuously during the sonar survey. A typical crossing of the pipeline is provided in (Figure 12). It shows the relative change in field strength over the ambient background as the pipeline is crossed.

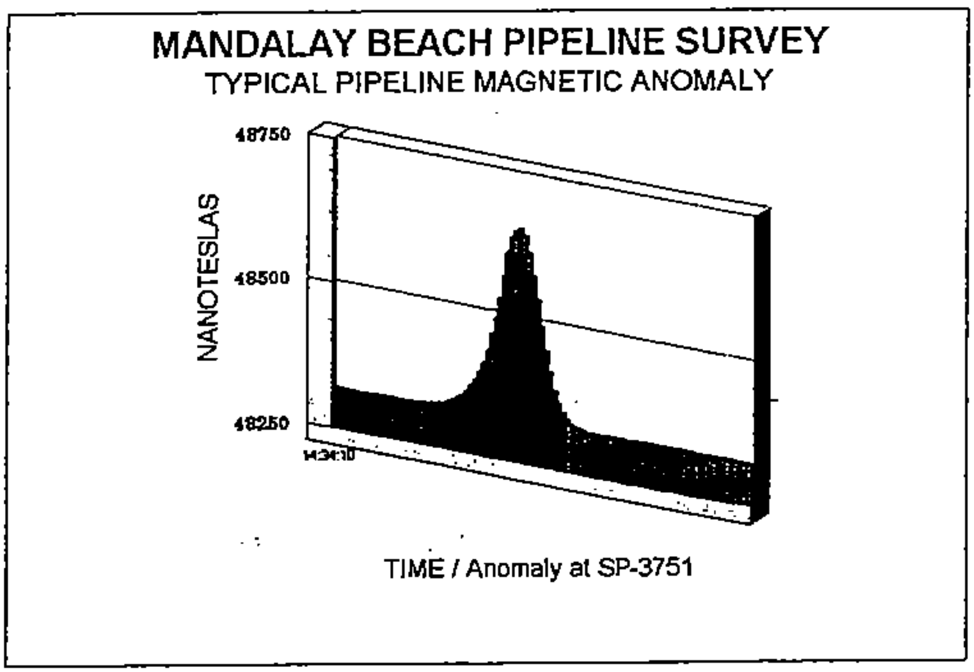


Figure 12 Shows a typical magnetic anomaly of the pipeline.

Numerous magnetic anomalies, that showed pipeline locations, were recorded during the survey. The magnetic anomaly map is provided in Figure 13. Anomalies are also shown that are not related to the pipeline structure. The anomalies are both magnetic and non-magnetic and are derived from the magnetometer data and the 3.5 kHz sub-bottom profiler. The Torch Oil pipeline (~ 1500' south of the Mandalay line) was also noted in the data collected.

Integrated Beach and Offshore Results

The bathymetry of the bottom offshore and the elevations of the dunes and beach are shown together in Figure14. The reference datum used in this composite figure is "mean lower low water (MLLW) equal to zero meters (see Table 2 for datum). The diver survey in the surf zone, conducted on 22 March 2000, confirmed that the sea floor is characterized by a flat sandy bottom with no observable outcropping of hard substrate and with typical broken zone sand bars.

The sub-bottom location of the pipeline is also shown in Figure 10, as recorded from the 3.5 kHz sonar profiler data collected on 28 February 2000. Onshore and in the surf zone, the pipeline was located using a hand held magnetometer on the final, 22 March 2000, survey of the beach. A three foot long rod was used to probe for the pipeline in many locations. In one location, normally in the surf zone but exposed at low tide, a three foot hole was dug and probed for another three feet. The pipeline was not located by any of the probes indicating the depth of sand was at least three feet and possibly greater than six feet over the pipeline.

Figure 13. Bathymetry, Substrate Type, Magnetic Anomalies, and Parabolic Reflectors from Sub-bottom Profiler Offshore of the Mandalay Power Generating Station (March 2000)

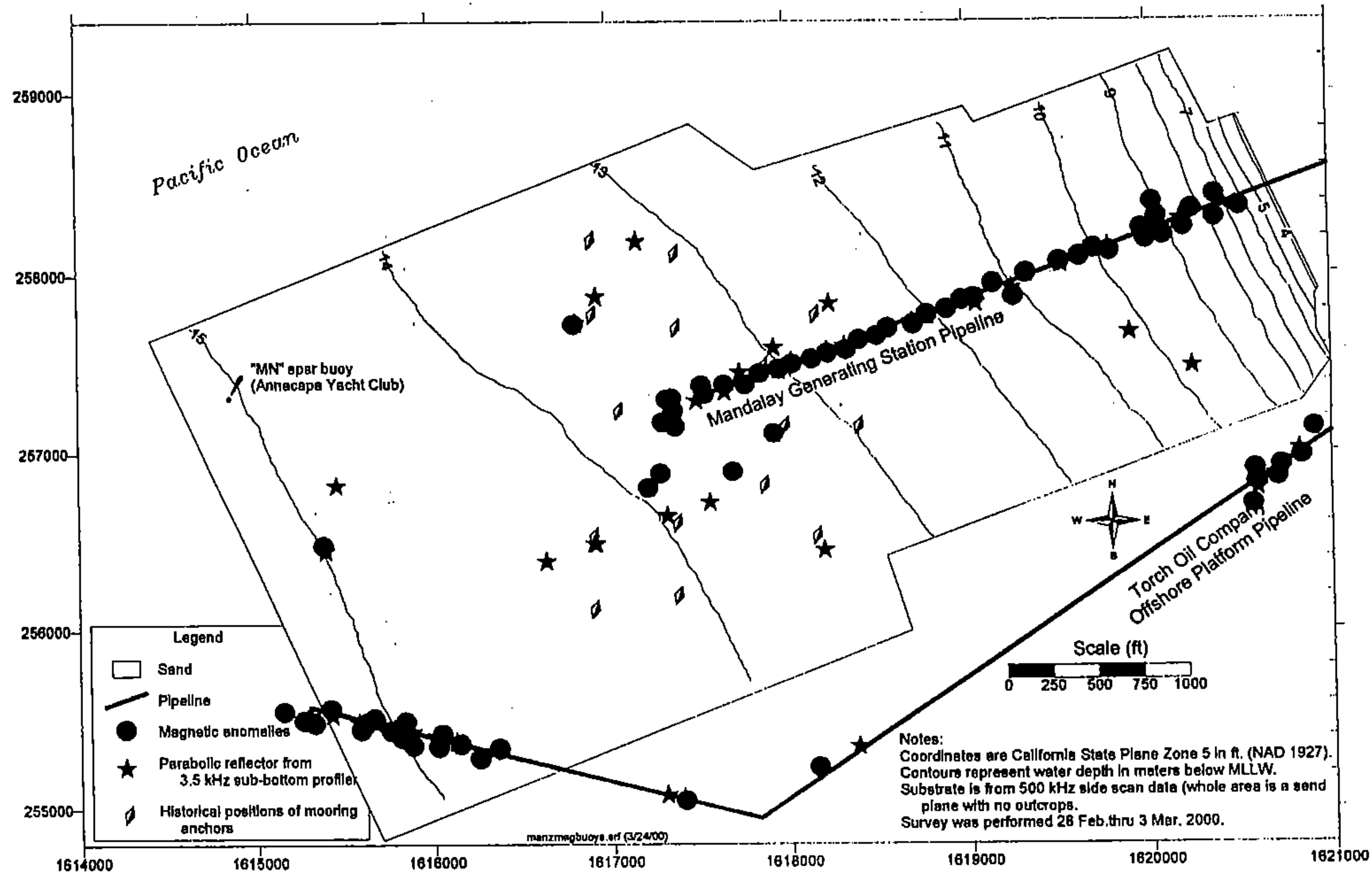
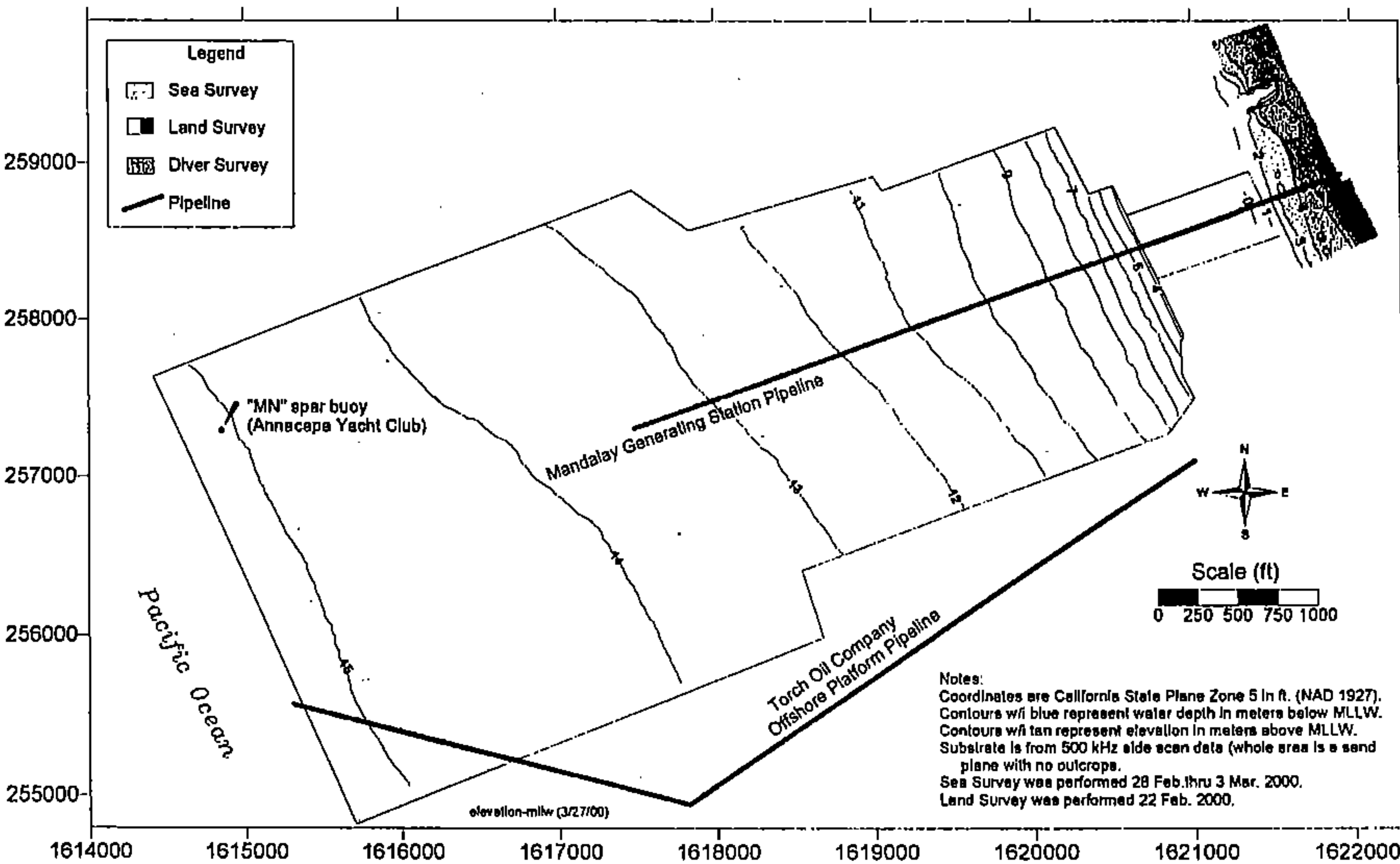


Figure 14. Elevations from Sea Survey and Land Survey Offshore of the Mandalay Power Generating Station (February-March 2000).



7. DISCUSSION AND CONCLUSIONS

The Mandalay Pipeline Geophysical Survey Project was conducted between 2 February and 22 March 2000. This survey project is the initial component in obtaining the necessary environmental information for the Mandalay Pipeline abandonment process as obligated under the lease agreement with the California State Lands Commission. The Mandalay Pipeline is a single 24 inch diameter, 4950 foot long, marine pipeline that was used to off-load fuel oil from ships for use by the Mandalay Generating Station along the Oxnard-Ventura beach. The pipeline was capped off at the offshore end in 1992 and has been in "caretaker" status with State Lands since then. The pipeline's series of ship and marker anchor buoys and chains were removed in 1992, as were at least two of the 16 anchors.

<u>Phase 1:</u> Beach, Dunes, and Surf Zone Survey, 2 February, 16-17 February, and 22 March 2000:

The beach and dunes adjacent to and over the buried pipeline were surveyed using standard topographic survey techniques. An area along 1,500 feet of beach frontage and 450 feet wide from an inland set of fences, through the up-shore sand dunes, and out into the breaker zone was surveyed. This area of about 16 acres was surveyed: Elevations were collected at 50 foot increments along predetermined lines. A hand-held/backpack magnetometer was also employed in the beach survey. Further, diver observations in the surf zone were made. The up-shore point where the pipeline traverses the dunes was found to be about 16 to 19 feet above the shoreline wet-zone elevations. The remaining beach elevations are more typical, showing a relatively flat beach with the exception of a pronounced 3 to 6 foot vertical berm at the inland edge of the high-tide wave run-up zone. The magnetometer provided confirmation of the position of the pipeline as it ran under the beach and into the surf zone. But, probing and cursory digging did not reveal the pipeline's exact depth under the beach. It is assumed to be at least 3 feet below the sand at the beaches' lowest elevations, and more likely is at least 6 feet below the beach, generally.

Phase 2: Boat Sonar, Magnetometer, and Diver Survey
21-28 February and 3 March 2000:

The sea floor was surveyed using standard side-scan and sub-bottom sonar and magnetometer techniques as well as by divers making visual observations. The marine survey encompassed a 447 acre area using a 100 foot grid and provided a 400% overlap in coverage. The zone surveyed was approximately 3000 feet in the long-shore direction by 6500 feet in the offshore direction to assure coverage around the anchoring points as well as the pipeline position.

The bathymetry results show an evenly prograding sand-covered sea floor from the inshore to the offshore. The survey results indicate the Mandalay Pipeline is generally covered with over 3 feet of sand but by up to 7 feet of sand. Further, the sonar record and diver observations show the area has a coarse sand bottom varying in depth from about 7 feet in the further offshore locations to 21 feet in depth inshore. Under this top-layer of coarse sand, the area appears to have a more consolidated sub-bottom as depicted by the sub-bottom sonar record. The sub-bottom layer, as indicated by the primary sub-bottom horizon in the sonar record, could be composed of material with more silts and clays than the surface coarse sand. The sonar data suggests it is not a hard substrate such as bedrock or a boulder cobble field.

The side-scan and diver survey results in the offshore area where the anchors were positioned show the sea floor to be uninterrupted sand. The sub-bottom sonar and magnetometer results in this area show some magnetic and non-magnetic anomalies in addition to the pipeline itself. These "hits" in the survey record could be indicative of the metal and concrete anchors that were left in place when the anchor chains, anchor buoys, and some of the anchors were removed. Comparison of the location of these "hits" to the position of the anchors on the original blue prints of the project from 1973 show that these survey positions are near, but not necessarily always at the exact "design" positions. This could be due to the anchors having been moved slightly or progressively during routine moorings of the oil supply ships over time, or due to the anchors not being initially placed with absolute accuracy because of the limits of the positioning technology available in 1973. Further, some of the sub-bottom "hits" in this present offshore survey, especially the ones not near the original anchor positions, could merely be indicating the presence of buried shell or cobble patches.

The offshore sonar and magnetometer survey was intentionally extended south along some of the long-shore tracks to determine the distance and location of another known pipeline, the Torch Oil Pipeline. This effort was successful, and the Torch Oil Pipeline was determined to be buried below the sand bottom and located approximately 1500 feet south of the Edison Mandalay Pipeline.